



Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service¹

This standard is issued under the fixed designation A 389/A 389M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope *

1.1 This specification covers alloy steel castings, which have been subjected to special heat treatment, for valves, flanges, fittings, and other pressure-containing parts (Note 1) intended primarily for high-temperature service.

1.2 The high-temperature properties of the materials covered in this specification are dependent upon special heat treatment that is required. Although the high-temperature properties are not specified, they are implied by control of chemistry, heat treatment, and room-temperature properties.

1.3 Two grades of ferritic alloy steel are covered (Note 2). Selection will depend on the design and service conditions, mechanical properties, and high-temperature characteristics.

NOTE 1—Carbon steel castings for pressure-containing parts are covered by Specification A 216/A 216M. Alloy steel castings are covered by Specification A 217/A 217M.

NOTE 2—The grades covered by this specification represent materials that are generally suitable for assembly with other castings or wrought steel parts by fusion welding. It is not intended to imply that these grades possess equal degrees of weldability; therefore, it is the responsibility of the purchaser to establish for himself a suitable welding technique. Since these grades possess varying degrees of suitability for resistance to oxidation and for high-temperature service, it is also the responsibility of the purchaser to determine which grade shall be furnished, due consideration being given to the requirements of the applicable construction codes.

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.18 on Castings.

Current edition approved April, 10 2003. Published April 2003. Originally approved in 1955. Last previous edition approved in 1998 as A 389 – 93 (1998).

A 216/A 216M Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service²

A 217/A 217M Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service²

A 488/A 488M Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel²

A 703/A 703M Specification for Steel Castings, General Requirements, for Pressure-Containing Parts²

2.2 *Manufacturers' Standardization Society of the Valve and Fittings Industry Standard:*

SP-55 Quality Standard for Steel Castings for Valves, Flanges, and Fittings and other Components (Visual Method)³

3. General Conditions for Delivery

3.1 Material furnished to this specification shall conform to the requirements of Specification A 703/A 703M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of A 703/A 703M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and A 703/A 703M, this specification shall prevail.

4. Ordering Information

4.1 The inquiry and order should include or indicate the following:

4.1.1 A description of the casting by pattern number or drawing (dimensional tolerances shall be included on the casting drawing),

4.1.2 Grade of steel,

4.1.3 Options in the specification, and

4.1.4 The supplementary requirements desired including the standards of acceptance.

² *Annual Book of ASTM Standards*, Vol 01.02.

³ Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602.

*A Summary of Changes section appears at the end of this standard.

5. Heat Treatment

5.1 All castings shall receive a heat treatment proper to their design and chemical composition. Heat treatment shall be performed before machining except in instances when reheat treating is necessary. All castings shall have been allowed to cool, after pouring, to a temperature below the critical range before heat treatment.

5.2 At the option of the manufacturer the castings may be given any preliminary heat treatment that will aid in their processing.

5.3 All castings shall receive a final heat treatment consisting of normalizing and tempering at the temperature prescribed for each grade in Table 1.

5.4 Furnace temperatures for heat treating shall be effectively controlled by use of pyrometers.

6. Chemical Composition

6.1 The steel shall conform to the requirements as to chemical composition prescribed in Table 2.

7. Tensile Requirements

7.1 Steel used for the castings shall conform to the requirements as to tensile properties prescribed in Table 3.

8. Quality

8.1 The surface of the casting shall be examined visually and shall be free of adhering sand, scale, cracks, and hot tears. Other surface discontinuities shall meet the visual acceptance standards specified in the order. Visual Method SP-55 or other visual standards may be used to define acceptable surface discontinuities and finish. Unacceptable visual surface discontinuities shall be removed and their removal verified by visual examination of the resultant cavities. When methods involving high temperature are used in the removal of discontinuities, castings shall be preheated to at least the minimum temperatures in Table 4.

8.2 The castings shall not be peened, plugged, or impregnated to stop leaks.

9. Repair by Welding

9.1 Repair shall be made by using a welding procedure and operators qualified in accordance with Practice A 488/A 488M. The composition of the deposit weld material shall be similar to that of the casting, or of other composition as may be agreed

TABLE 1 Heat Treating Temperatures

| Grade | Normalizing Temperature, °F[°C] | Tempering | |
|-------|---------------------------------|------------------------|-----------------|
| | | Temperature, °F[°C] | Holding Time, h |
| C23 | 1850–1950 [1010–1065] | 1250–1350 [675–730] | 1 ^A |
| C24 | 1850–1950 [1010–1065] | 1250–1350 [675–730] | 12 |

^A Per inch or less of thickness.

TABLE 2 Chemical Requirements

| Grade (UNS No.) | Composition, % | |
|-----------------|----------------|--------------|
| | C23 (J12080) | C24 (J12092) |
| Carbon, max | 0.20 | 0.20 |
| Manganese | 0.30–0.80 | 0.30–0.80 |
| Phosphorus, max | 0.04 | 0.04 |
| Sulfur, max | 0.045 | 0.045 |
| Silicon, max | 0.60 | 0.60 |
| Chromium | 1.00–1.50 | 0.80–1.25 |
| Molybdenum | 0.45–0.65 | 0.90–1.20 |
| Vanadium | 0.15–0.25 | 0.15–0.25 |

TABLE 3 Tensile Requirements

| Grade | C23 | C24 |
|--|-------------|-------------|
| Tensile strength, min, ksi [MPa] | 70 [483] | 80 [552] |
| Yield strength, ^A min, ksi [MPa] | 40 [276] | 50 [345] |
| Elongation in 2 in. [50 mm], min, % ^B | 18.0 | 15.0 |
| Reduction of area, min, % | 35.0 | 35.0 |

^A Determine by either 0.2 % offset or 0.5 % extension-under-load method.

^B When ICI test bars are used in tensile testing as provided for in Specification A 703/A 703M, the gage length to reduced section diameter ratio shall be 4 to 1.

TABLE 4 Minimum Preheat Temperature

| Grade | Minimum Preheat Temperature, °F[°C] |
|-------|-------------------------------------|
| C23 | 300 [150] |
| C24 | 300 [150] |

upon between the manufacturer and the purchaser. The castings after complement of weld repairing shall be retempered except that local tempering of the weld repairs will be permitted if, in the manufacturer's opinion, complete furnace-heat treatment would be damaging to the finished surfaces of a machined casting. Heat treatments after weld repair other than tempering shall be performed only when agreed upon between the manufacturer and the purchaser.

9.2 Weld repairs shall be considered major in the case of a casting that had leaked on hydrostatic test, or when the depth of cavity prepared for welding exceeds 20 % of the actual wall thickness or 1 in. [25.4 mm], whichever is smaller, or when the extent of the cavity exceeds approximately 10 in.² [64.5 cm²]. When requested by the purchaser's inspector, such weld repairs shall be subject to his approval. He shall also have the right to require complete reheat treatment of the repaired casting in accordance with 5.3. When mutually agreed upon between the purchaser and the manufacturer, major repair weld may be examined at the manufacturer's expense by magnetic particle examination or radiographing, or both, to check the adequacy of the repair.

10. Keywords

10.1 steel castings; alloy steel; pressure containing parts; high temperature applications



SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall not apply unless specified in the purchase order. A list of standardized supplementary requirements for use at the option of the purchaser is included in Specification A 703/A 703M. Those which are ordinarily considered suitable for use with this specification are given below. Others enumerated in Specification A 703/A 703M may be used with this specification upon agreement between the manufacturer and purchaser.

S1. Residual Elements Chemical Analysis

S2. Destruction Tests

S3. Bend Tests

S4. Magnetic Particle Inspection

S5. Radiographic Inspection

S10. Examination of Weld Preparation

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes made to this standard since the last issue (A 389/A 389M–93 (1998)) that may impact the use of this standard.

(1) Added the UNS Numbers to the grades in Table 2.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).